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ABSTRACT

Version 3 of the Southwest Regional Laboratory's (SWRL) Instructional Management System (IMS) is a fully automated system which accepts pupil criterion exercises from remote sites and returns various reports to the same location. This paper briefly describes the SWRL/IMS system design and functional characteristics. The instructional system requisites and longer-range development objectives related to IMS functions are summarized, and examples of criterion exercises, system reports, and input forms are provided. A flowchart of the data collection, concentration, and information generation process is also included. (Author/DGC)

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DATE: January 27, 1971

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TITLE: FUNCTIONAL OVERVIEW OF SWRL/IMS VERSION 3

AUTHOR: John F. McManus

ABSTRACT

Version 3 of the SWRL Instructional Management System (IMS), is a fully automated system which accepts pupil criterion exercises from remote sites and returns reports to the same location. This paper briefly describes the SWRL/IMS Version 3 system design and functional operation.

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FUNCTIONAL OVERVIEW OF SWRL/IMS VERSION 3

BACKGROUND

SWRL is developing an Instructional Management System to provide timely and convenient information to various users concerning the instructional progress of individual students. SWRL/IMS Version 3 will be tested in schools during the 1971-72 school year. The test will constitute a real-time tryout of a fully automated system from data source to computer processing to remote output. It will also provide a vehicle for the further development of the four functions delineated below that constitute the longer-range IMS objectives.

This paper briefly describes the SWRL/IMS Version 3 system design and functional operation. To provide a background for this overview, the instructional system requisites and longer-range development objectives related to IMS functions are summarized.

Instructional System Requisite

IMS is being developed to operate in conjunction with instructional systems possessing a common subset of characteristics. The first is a set of pre-defined educational objectives stating operationally what proficiency the pupils should exhibit at measured intervals during instruction. The second is the instructional materials. These may take diverse forms, ranging from text books and flash cards to audio tapes. The third characteristic is instructional procedures. Specified procedures are organized to facilitate use by teachers consistent with operations shown to be effective. The fourth characteristic comprises assessment instruments to determine pupil proficiency. The responses to these machine scannable criterion exercises may be multiple-choice item answer

sheets (selected responses) or teacher-recorded verbal answers (constructed responses). The fifth is performance decision rules to determine reasonable instructional consequences. When pupil attainment is below a pre-specified level, supplemental instruction, the sixth characteristic, is in order.

IMS is designed for successful operation with instruction systems possessing the above characteristics. The SWRL First Year Communication Skills Program (FYCSP) was designed specifically with these in mind. IMS may also be used with other existing systems which have been augmented by the addition of objectives, assessment materials and supplemental instruction.

The Learning Mastery System (LMS) has incorporated two California state-adopted reading texts and has made them usable with the Instructional Management System.

INSTRUCTIONAL MANAGEMENT SYSTEM FUNCTIONS

When completely developed SWRL/IMS will perform four specific functions: (1) scoring and reporting of student performance data; (2) maintenance and updating of cumulative information across student, group, class or teaching unit; (3) diagnosis of learning proficiency and prescription of appropriate instructional sequences to those pupils who do not reach criterion; (4) computer generation of instructional materials to assist pupils in attaining criterion.

Function 1 - Scoring and Reporting. Criterion Exercises are corrected and scored by computer. The following information can be returned to the classroom:

. pupil scores

. group scores and averages

. class scores and averages

. item analyses of the criterion exercises

. other statistical analyses on exercise data

This is bread-and-butter instructional information. The power of IMS derives from making the information available in a timely and convenient form adapted to the requirements of various users.

Function 2 - File Maintenance and Updating. This function is a key IMS component. Both researchers and school personnel need a record of cumulative data to study overall performance and trends in student learning, and to evaluate the instructional measuring instruments. To accomplish this, an effective design of file structures, cross reference tables, and pointers must be constructed.

Function 3 - Diagnosis and Prescription. Students who do not reach criterion on unit exercises are identified by Function 1. One method of assisting teachers to bring children to an acceptable level of performance is the use of diagnostic procedures to pinpoint student, group, or class problems. Here, the comprehensive data files of Function 2 are required to evaluate longitudinal data and prepare pupil performance profiles in an attempt to isolate specific learning difficulties. For those students whose achievement is deemed below criterion, remedial suggestions will be prescribed to the teacher.

Function 4 - Computer-Generation of Instructional Materials. The three preceding functions provide suggestions to the teacher as to which materials to use for specific problems. Function 4 will provide computer-generated prescriptive materials to overcome specific learning difficulties. To accomplish this instructional algorithms must be designed and tested.

Hardware Configuration

The SWRL/IMS Version 3 hardware configuration will fully automate the instructional management system from data source to computer processing to remote output.

Data source input. Criterion exercise sheets will be entered into low-speed, low-cost reliable optical scanners located in schools or district offices. This teletype compatible machine, developed by the Optical Scanning Corporation, will transmit data in a dial-up mode through a Bell 103A data set to the SWRL data concentrator.

Computer processing. The processing of the criterion exercise data will be carried out by a data concentrator on-line to a large control processor. The concentrator, located at SWRL, is of the following configuration: a Digital Equipment Corporation PDP-8/I computer with teletype, 8K of core, 64K of fixed disk, three PEC tape drives, a card reader, high-speed paper tape reader/punch, line printer, and CRT. The PDP-8 in turn will be connected over a 2000 BAUD line to a Univac 1108 computer located at the Jet Propulsion Laboratory in Pasadena, California. This machine operates under EXEC 8 and it is capable of handling remote job entry.

Data output. Reports from IMS will be transmitted directly to the school or district office by the data concentrator, which receives the reports from the 1108 and stores them on magnetic tape. The output devices will be either teletype or low-speed line printers. Once received, the reports are distributed to the appropriate teacher.

Software Design

Two separate but interrelated concepts are contained in the software design of a CMI system - the communications software and the resident IMS programs.

Communications software. SWRL/IMS Version 3 will use the SWRL executive system. Operating in a data break mode, the system can handle multiple interrupts from ten hardware ports. The communications programming is modular; the PDP-8 could communicate with any other computer if the code for that machine were known and if the hardware interface were available.

Resident IMS software. The programs to generate reports to teachers, administrators and researchers will reside on the 1108 computer. They will be written in FORTRAN IV to minimize the problems of reprogramming for another machine.

IMS OPERATIONAL SEQUENCE

The activities pertinent to SWRL/IMS Version 3 are carried on in three separate locations, each requisite for successful instructional management. These are the school, the data concentrator, and the central processor. The following describes the operation in a typical school containing four kindergarten classes.

School

Pupils receive instruction in Unit One of the First Year Communications Skill Program. When the presentation of materials and practice exercises is completed, the pupils take a criterion referenced exercise for Unit One. It is administered orally by the teacher and the pupils respond by

filling in their choice of response position for each question. There are four 8½" X 11" answer sheets, each containing five items with three possible responses per item. Stimuli are presented for each item and there is space beneath each for student marking. A sample answer sheet appears in Appendix A.

When the tests have been completed, they are brought to the scanner where a clerk checks the answer sheets for stray marks and smudges. The test sheets preceded by a control sheet identifying the district, school, class, session, subject, and test number are fed into the scanner, which is connected to the data concentrator by means of a telephone and data set. The scanner then transmits a pattern of information bits to the concentrator. When all the sheets have been read, the scanner is turned off and the phone returned to its cradle.

Data Concentrator Site

As soon as the scanner is connected over telephone lines to the data concentrator, all processing is stopped to receive the information. The source of transmission is identified and the first series of bits is stored in a buffer. Since a bit pattern image of the entire test page containing stimuli and responses is transmitted, the concentrator must strip the data and save only those bits contained in the response position areas. This information is placed in disc storage and then later stored on magnetic tape.

Central Computer

The main computer receives a call from the data concentrator to open files for the reception of data. These two machines are connected by high-speed direct dial telephone lines. Once the data have been

received by the large CPU, the concentrator will signal the activation of certain pre-stored programs to operate on the data. These programs correct the tests and generate scores for each outcome and total test for each pupil and store this information on a temporary output file. The same data is stored in the permanent Function 2 data base.

Data Concentrator

Upon call from the concentrator the scores are returned from the output file to a temporary input file at the smaller machine. The data concentrator then initiates a call to the school which has a teletype or line printer and a data set in the ready condition. Reports are output for use by school personnel. Sample output reports appear in Appendix B.

In summary, the critical tasks by location are as follows:

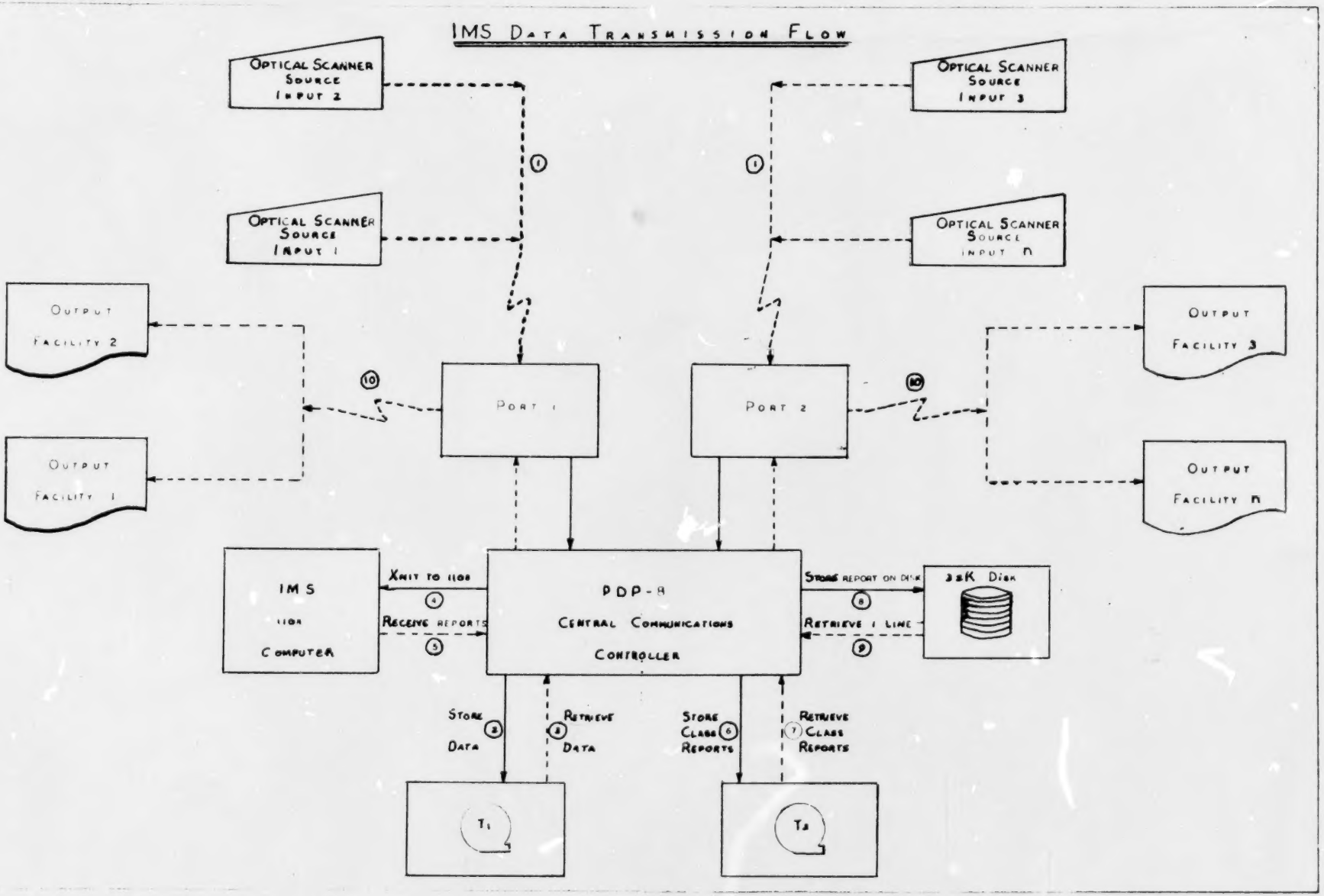
School - instruction, administration of criterion exercises, transmission of exercise information, reception of summary reports.

Data Concentrator - identification of transmission source, reception and stripping of data, temporary storage of raw data, transmission of data to large CPU, reception of summary reports, transmission of reports to school site.

Central Computer - reception of compacted raw data, scoring of exercises, updating of files, transmission of summary reports to data concentrator.

The complete process is depicted in Figure 1.

Figure 1


IMS Data Transmission Flow
Optical Scanner Source Input 2
Optical Scanner Source Input 3
Optical Scanner Source Input 1
Optical Scanner Source Input n
Output Facility 2
Output Facility 3
Output Facility 1
Output Facility n
Port 1
Port 2
IMS 11/08 Computer
Xmit to 11/08
Receive Reports
PDP-8 Central Communications Controller
Store Report on Disk
Retrieve 1 Line
32K Disk
Store Data
Retrieve Data
Store Class Reports
Retrieve Class Reports
T1
T2

Criterion Exercise 14

...ppy ☐	hurt ☐	hurry ☐	dirty ☐
y...rn ☐	yell ☐	turn ☐	hurt ☐
...r ☐	ark ☐	eck ☐	art ☐
...r ☐	art ☐	ort ☐	ote ☐
...rt ☐	past ☐	port ☐	sort ☐

Appendix B

Class Performance Report - Criterion Test 4-1
(Sample)

District Westport (1)
School Eleventh Street School (1)
Teacher Eve Campbell (1)
Class Morning (1)

ID No.	Student's Name	(Group)	Total Raw Score	Outcome Score in Percentages Outcome 1	Outcome 2	Outcome 3
1	John Phillips	1	24	100	100	100
25	Martin Maloney	1	24	100	100	100
2	Alice Smith	1	24	100	100	100
7	Dianne Albers	1	24	100	100	100
13	Janet Gates	1	23	100	100	88
8	Jose Delgado	1	23	100	100	88
14	Mary Harris	1	22	100	100	75*
19	Helen Teary	1	22	100	88	88
20	Arthur Olson	1	21	100	88	75*
		Group Averages		100	97	90
3	Pamela Peters	2	22	100	100	75*
4	Fred Harper	2	21	100	100	63*
10	Patty Kendall	2	21	100	88	75*
9	Bill Riley	2	21	100	88	75*
15	Dave Nelson	2	20	100	88	63*
16	Kurt Rotter	2	20	88	88	75*
22	Jim Cook	2	20	88	88	75*
21	Sally Tennon	2	20	88	88	75*
		Group Averages		96	91	72*
24	Juan Martinez	3	18	100	75*	63*
23	Lillian Horn	3	18	88	75*	50*
18	Donald Gray	3	17	88	63*	50*
17	Sylvia Strickland	3	17	88	63*	50*
11	Maurice Richter	3	15	75*	63*	38*
12	Sibyl Betts	3	15	75*	63*	38*
6	Ben Kaufman	3	12	75*	50*	25*
5	Danny Robinson	3	10	63*	37*	25*
		Group Averages		82	61*	42*
		Class Averages		93	83	68

* Indicates that score was below criterion.

Class No. 1

Unit No. 4

Group No. 1

Student No.	Outcomes 1	2	3	4	Total
1			4		19
2		3	3	2	13
3		4	4		18
Percent of Group Below 5 out of 5	0	67	100	33	

Group No. 2

Student No.	Outcomes 1	2	3	4	Total
4					20
5		4			19
6					20
7	4	4	4	4	16
Percent of Group Below 5 out of 5	25	50	25	25	
Percent of Class Below 5 out of 5	14	57	57	29	

Unit No. 4

Item No.	Percent Giving Response			Correct Response
	1	2	3	
1	70 CAT	20 CAR	10 CUP	70 CAT
2	40 DOG	0 DIG	60 DOT	60 DOT
.				
.				
.				
.				
.				
.				
20	30 S	50 C	20 Z	50 C

ITEM ANALYSIS REPORT BY OUTCOME CRITERION TEST 4-1
(Sample)

District Westport (1)
School Eleventh Street School (1)
Teacher Eve Campbell (1)
Class Morning (1)

Outcome No.	Page No.	Row No.	Correct Response	Response Position 0	1	2	3
1	1	1	2	0	1	24	0
	1	2	1	0	25	0	0
	2	1	1	0	24	1	0
	2	2	2	0	1	23	1
	3	1	2	0	0	22	3
	3	2*	2	1	2	19	3
	4	1	3	0	0	3	22
	4	2	3	1	1	1	22
2	1	3	3	0	0	0	25
	1	4	2	0	1	22	2
	2	3*	1	0	20	0	5
	2	4*	3	0	5	2	18
	3	3*	1	0	21	2	2
	3	4*	3	0	6	0	19
	4	3*	1	0	18	2	5
	4	4*	2	0	2	16	7
3	1	5*	3	0	2	3	20
	1	6*	1	0	21	1	3
	2	5*	3	0	2	4	19
	2	6*	2	0	5	15	5
	3	5*	1	0	18	3	4
	3	6*	2	0	4	15	6
	4	5*	1	0	12	3	10
	4	6*	1	0	12	7	6

Figure 4